

## Flint River Embayment Wheeler Reservoir Intensive Basin Survey 2015

**WHEL-2:** Flint R approx 1 mi upstream of confluence with TN River (Madison Co 34.51073/-86.51411)

### BACKGROUND

The Alabama Department of Environmental Management (ADEM) began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program [now known as the Rivers and Reservoirs Monitoring Program (RRMP)] was initiated by ADEM.

The current objectives of this program are to provide data that can be used to assess current water quality conditions, identify trends in water quality conditions and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM’s 2012 Monitoring Strategy (ADEM 2012).

In 2015, ADEM monitored the Flint River tributary embayment of Wheeler Reservoir as part of the basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Flint River embayment (WHEL-2) during the 2015 growing season (Apr-Oct). This is the fourth basin assessment of the Tennessee River since ADEM began sampling. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chlorophyll *a* (chl *a*); algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson’s trophic state index (TSI)] from 2015 were compared to ADEM’s historical data and established criteria.



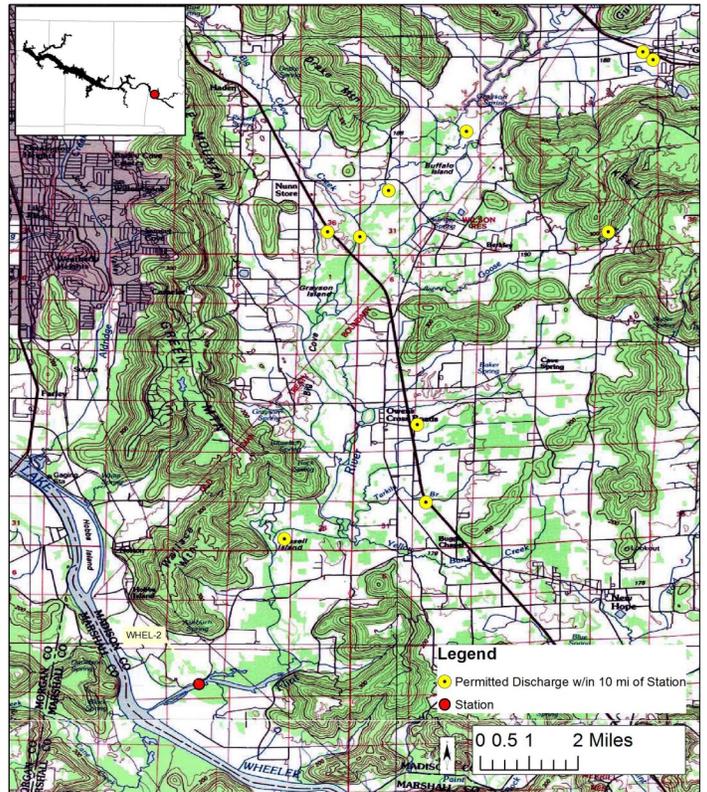
**Figure 1.** Photo of Flint R at WHEL-2.

### WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Flint River is classified as a *Fish & Wildlife (F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the 568 mi<sup>2</sup> watershed is predominantly agriculture [hay/pasture (27%) and crops (25%)] (Fig. 3). As of January 28, 2016, ADEM has issued a total of 360 NPDES permits within the watershed. Ten of those permits are located within 10 mi of the station (Fig. 2).

### SITE DESCRIPTION

The Flint River embayment at WHEL-2 is located south of Madison, AL. The upper portion of the watershed also includes parts of Huntsville. The riverine embayment flows into the Tennessee River near river mile 339. Flint R has a mean bottom depth of 4.96 m (Table 2) at the sampling location.



**Figure 2.** Map of the Flint R embayment of Wheeler Reservoir. Though additional permitted facilities may occur in the watershed (Table 1), only those within 10 miles upstream of the station are displayed on the map.

## METHODS

Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2015), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2015 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

## RESULTS

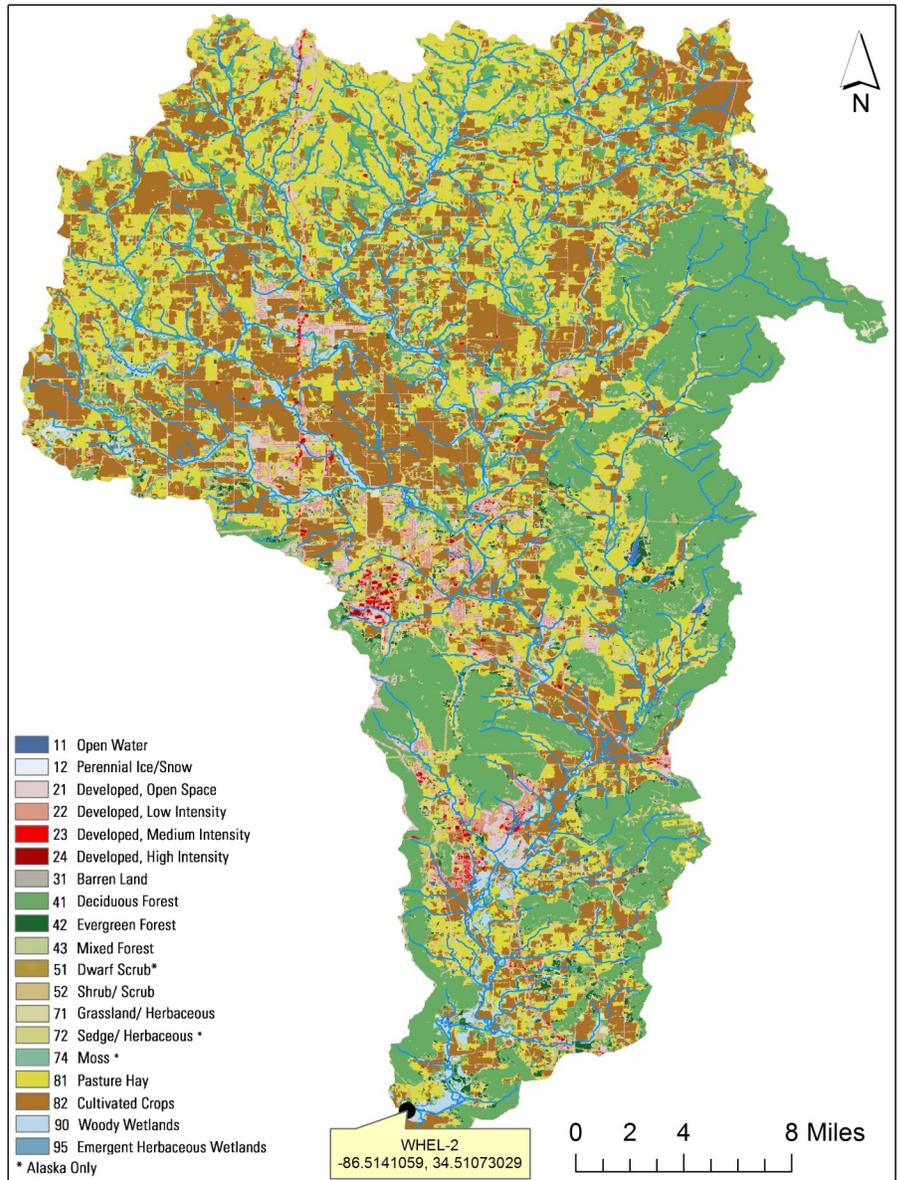
The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir-wide so all embayment reports on the same reservoir could be compared.

**Table 1: Summary of Watershed WHEL-2**

Basin	Tennessee R
Drainage Area (mi <sup>2</sup> )	568
Ecoregion <sup>a</sup>	71g
% Land use	
Open Water	<1%
Developed	Open Space 6%
	Low Intensity 2%
	Medium Intensity <1%
	High Intensity <1%
Barren Land	<1%
Forest	Deciduous Forest 27%
	Evergreen Forest 1%
	Mixed Forest 2%
Shrub/Scrub	4%
Herbaceous	1%
Hay/Pasture	27%
Cultivated Crops	25%
Wetlands	Woody 4%
	Emergent Herb. <1%
# NPDES outfalls <sup>b</sup>	TOTAL 360
Construction Stormwater	266
Mining	6
Small Mining	4
Industrial General	42
Industrial Individual	22
Municipal	7
Underground Injection Control	13

a. Eastern Highland Rim

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.



**Figure 3. Land use within the Flint River watershed at WHEL-2.**

While the mean growing season TN value was lower in 2015 than 2013, it has increased overall since 2003 (Fig. 4). Monthly TN concentrations were highest in August and October.

Mean growing season TP concentrations declined 2003-2013 and changed little in 2015 (Fig. 4). Monthly TP concentrations were generally low, highest concentrations were measured in October.

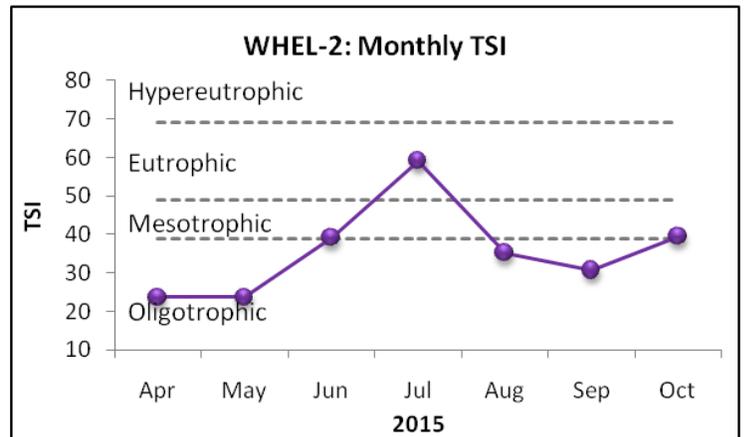
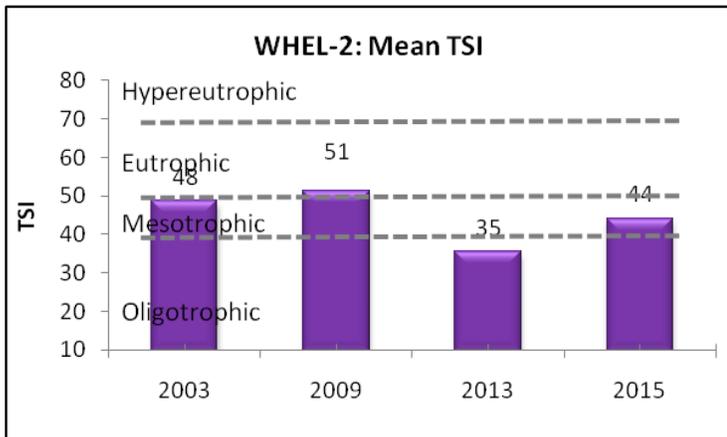
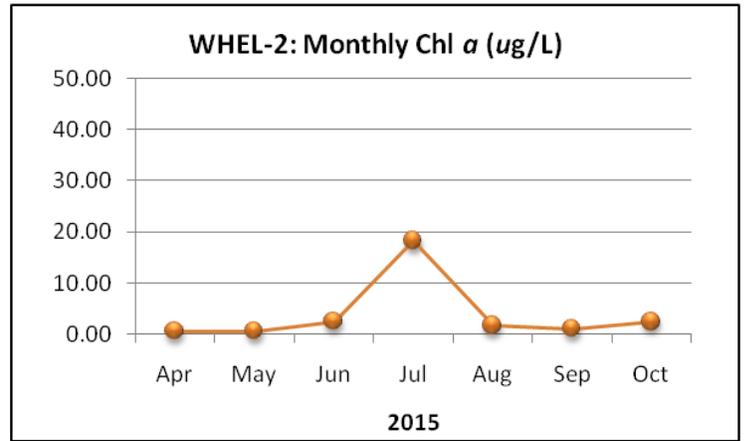
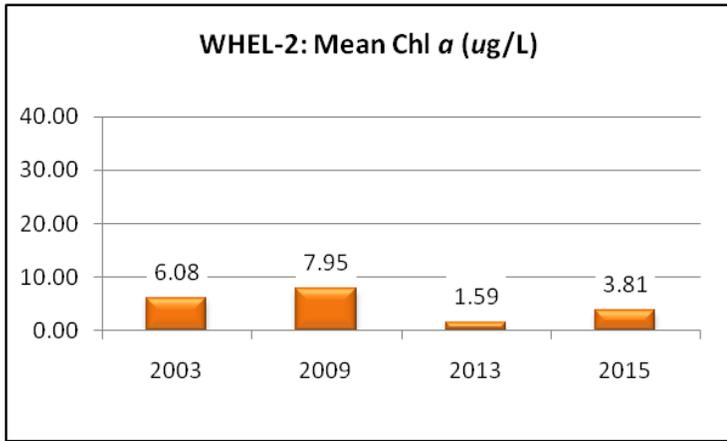
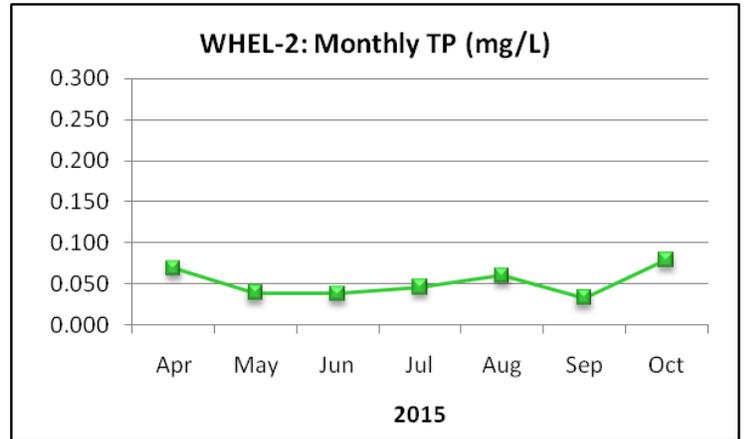
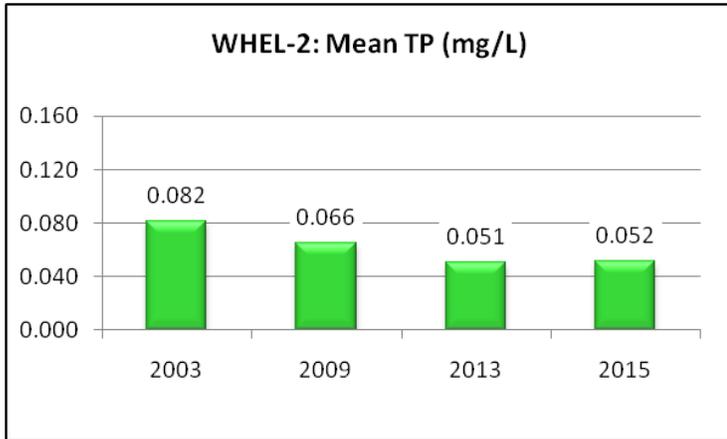
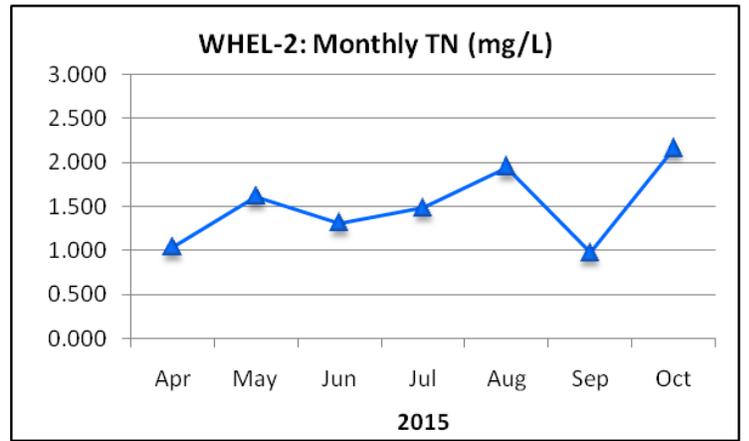
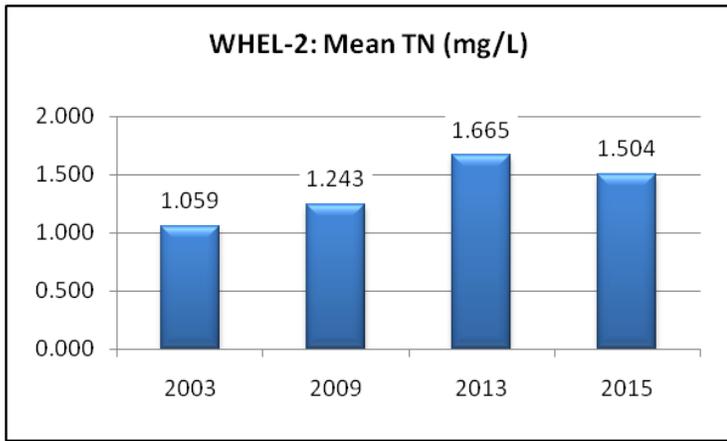
The mean growing season chl *a* value increased from 2013 to 2015 but remained lower than 2003 and 2009 (Fig. 4). Monthly chl *a* concentrations were low all months except July.

Mean TSI increased to mesotrophic in 2015 from oligotrophic in 2013, but values remained lower than in 2003 and 2009. Monthly TSI values reached eutrophic conditions in July (Fig. 4).

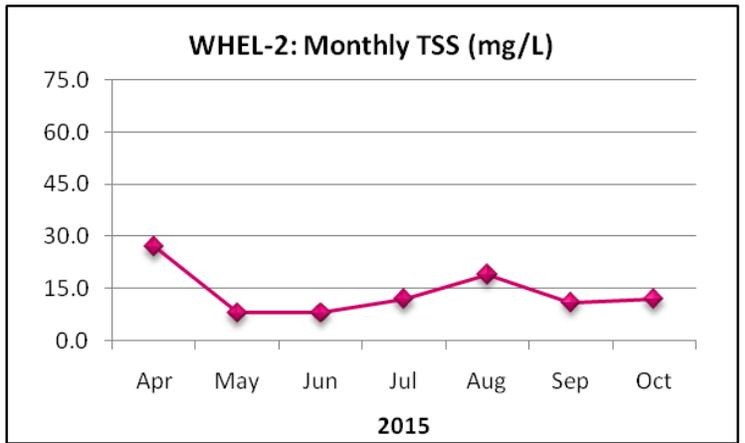
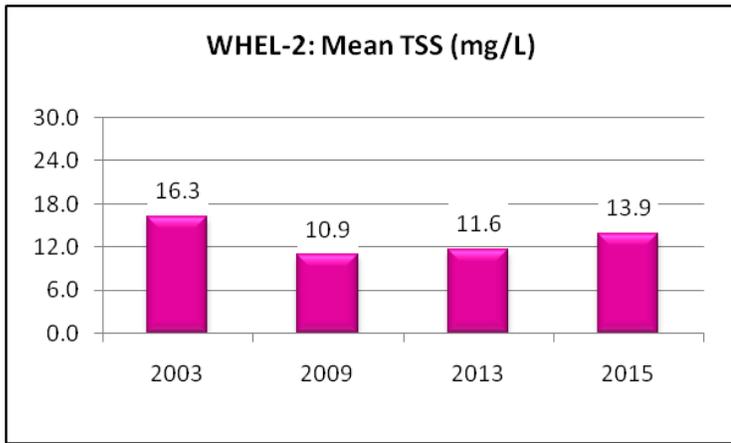
Mean growing season TSS values have increased 2009-2015 but have not reached as high as those measured in 2003 (Fig. 5). Monthly TSS concentration was highest in April.

No AGPT sample was collected from Flint River in 2015. Results from 2003-2013 are shown in Table 3.

The DO concentrations in the WHEL-2 station were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) all months monitored (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).



**Figure 4.** Mean growing season (2003-2015) and monthly (April-October, 2015) TN, TP, chl *a* and TSI measured in the Flint River embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



**Figure 5.** Mean growing season and monthly TSS measured in the Flint River embayment of Wheeler Reservoir.

**Table 2.** Summary of water quality data collected April-October, 2015. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

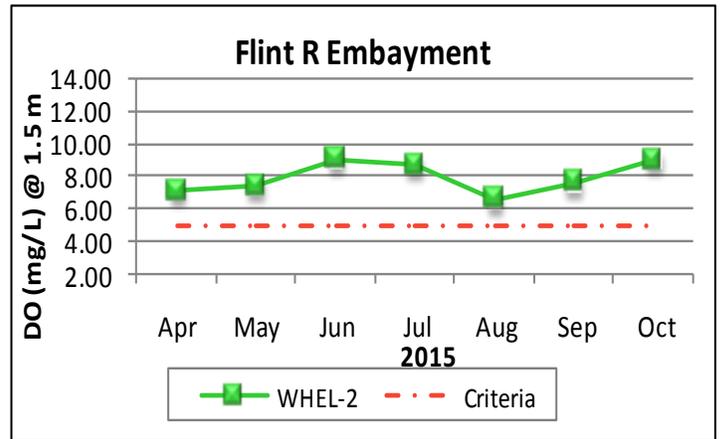
WHEL-2	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	9.2	38.1	11.0	14.6	10.4
Total Dissolved Solids (mg/L)	7	100.0	133.0	118.0	118.1	11.4
Total Suspended Solids (mg/L) <sup>J</sup>	7	8.0	27.0	12.0	13.9	6.9
Hardness (mg/L)	4	88.9	103.0	93.6	94.8	6.5
Alkalinity (mg/L)	7	77.3	95.3	90.7	87.0	7.6
Photic Zone (m)	7	1.49	3.64	3.12	2.83	0.69
Secchi (m)	7	0.53	1.29	0.94	0.89	0.24
Bottom Depth (m)	7	4.90	5.77	4.80	4.96	0.42
<b>Chemical</b>						
Ammonia Nitrogen (mg/L) <sup>J</sup>	7	< 0.007	0.084	0.005	0.019	0.029
Nitrate+Nitrite Nitrogen (mg/L)	7	0.495	1.584	1.208	1.140	0.416
Total Kjeldahl Nitrogen (mg/L) <sup>J</sup>	7	< 0.064	0.673	0.387	0.365	0.233
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.971	2.163	1.481	1.504	0.444
Dissolved Reactive Phosphorus (mg/L)	7	0.016	0.056	0.020	0.029	0.015
Total Phosphorus (mg/L)	7	0.033	0.079	0.046	0.052	0.018
CBOD-5 (mg/L) <sup>J</sup>	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	2.7	7.8	5.5	5.4	1.5
<b>Biological</b>						
Chlorophyll a (ug/L)	7	< 1.00	18.20	1.60	3.81	6.40
E. coli (col/100mL) <sup>J</sup>	3	9	13	10	11	2

J= one or more of the values is an estimate; N=# samples.

**Table 3.** Algal growth potential test results (expressed as mean MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
8/19/2003	8.28	PHOSPHORUS
8/18/2009	4.09	PHOSPHORUS
8/20/2013	16.87	PHOSPHORUS

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**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Flint R embayment station of Wheeler Reservoir collected April-October 2015. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

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- ADEM. 2013. Quality Management Plan (QMP) for the Alabama Department of Environmental, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
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